

PRIMITIVE CRYPTOSTIGMATID
MITES FROM RHODODENDRON
FORESTS IN THE NEPAL HIMALAYA



BY

J. G. SHEALS

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PRIMITIVE CRYPTOSTIGMATID MITES FROM RHODODENDRON FORESTS IN THE NEPAL HIMALAYA

By J. G. SHEALS

INTRODUCTION

THIS report forms the first of a series on the soil- and litter-dwelling Acari collected by the British Museum (Natural History) Expedition to East Nepal 1961-62. A full account of this expedition with details of the localities examined is given by Sheals & Inglis (1965). In spite of the outstanding biogeographical interest of the Himalayan region as a complex transitional zone, very little attention has been paid to the soil and litter fauna of the area. In so far as the Acari are concerned, small collections were made in 1954 by the British Museum (Natural History) Expedition to West Nepal. Some of this material has been utilized in revisionary studies (Hyatt 1956, Evans & Hyatt 1958, 1960), but apart from these no account of the Himalayan free-living mites appears to have been published since the report on a collection of Oribatidae from the Sikkim Himalaya by Pearce (1906).

The present paper is concerned with the taxonomy of the *Oribatei Inferiores* from Rhododendron forest soil and litter in four localities in East Nepal: a large forest of tree Rhododendrons (mainly *R. arboreum*) on the slopes of the Milke Danra ridge, 27° 19' N 87° 31' E, altitude 9,300-11,000'; an area of dwarf Rhododendron at Topke Gola, 27° 38' N 87° 35' E, altitude 12,500-13,000'; an area of tree and bush Rhododendron (mainly *R. arboreum*) at Selap, 27° 38' N 87° 49' E, altitude 10,100-10,300' and thickets of bush Rhododendron (mainly *R. arboreum*) on the crest of the Singalila ridge near Sandakphu, 27° 06' N 88° 01' E, altitude 12,000'. The higher Cryptostigmata and other mites from these localities will be dealt with in later papers.

In the descriptions the setal nomenclature used in the later works of Grandjean has been followed except in the case of the Nothroidea where it is convenient to follow the system used by Sellnick & Forsslund (1955). The type material is deposited in the British Museum (Natural History).

Family ACARONYCHIDAE Grandjean, 1932

*Himalacarus chimalae*¹ gen. et sp. nov.

ADULT. The prodorsum (figs. 1 & 2) is approximately 160 μ long and 140 μ wide at the broadest point level with the sensilli. There is a prominent obliquely projecting rostral protuberance (the naso of Grandjean, 1958) below which a bilobed eye such as Grandjean (op. cit.) has noted for other members of this family can easily be discerned. The rostral setae (ro) are stout, prominent, quite smooth and about 80 μ in length while the lamellar setae (la) are barbed and about 95 μ in length. The interlamellar setae (in) and the exobothridial setae (xi) are barbed and about 130 μ in length, while the exobothridial setae (xs) are short (approx. 30 μ long), smooth

¹From the Nepali *chimal* - certain tree Rhododendrons

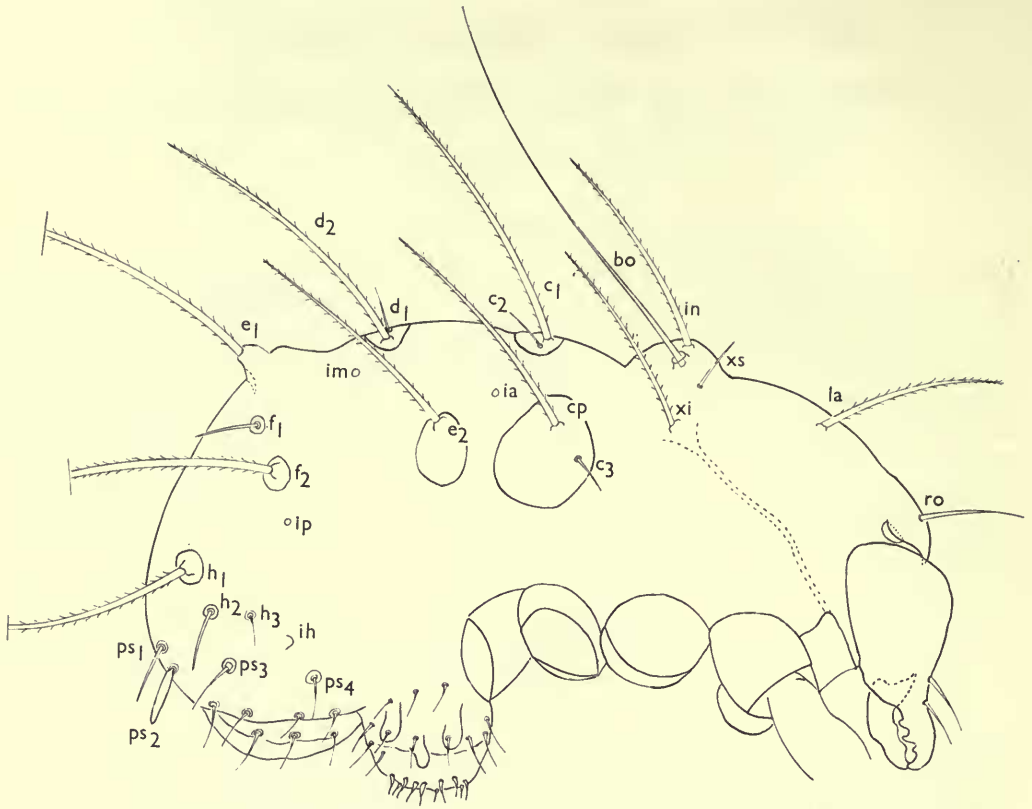
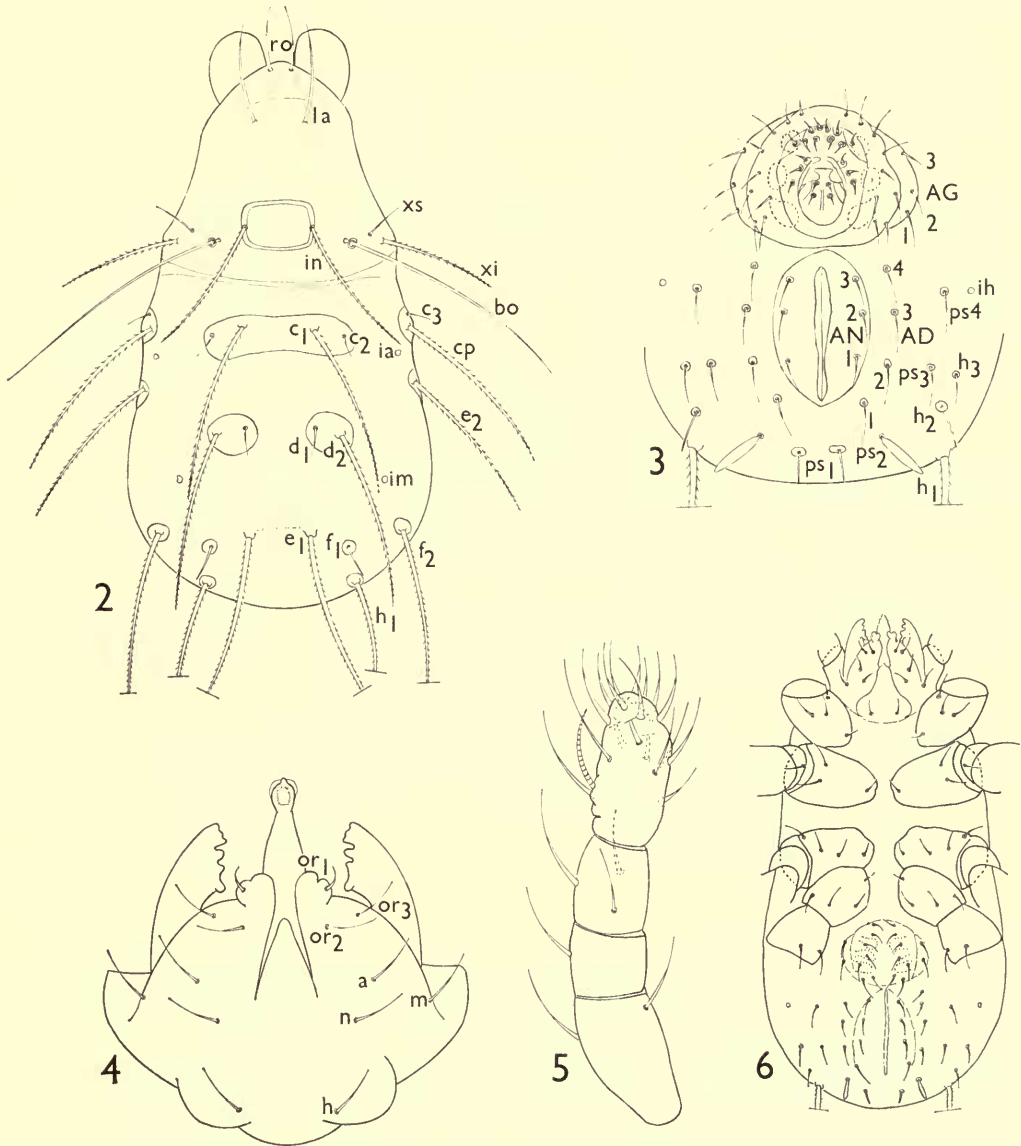


FIG. 1. *Himalacarus chimalae* gen. et sp. nov. Adult lateral.

and rather blunt. The sensillus (bo), 185–190 μ long, is quite smooth and tapers gradually to a fine point. A rectangular design evidently formed by a thickening of the cuticle can be discerned between the interlamellar setae; this is almost identical in form to the system of ‘chitinous nervures’ (false lamellae) described by Grandjean (1952) for *Stomacarus tristani*.

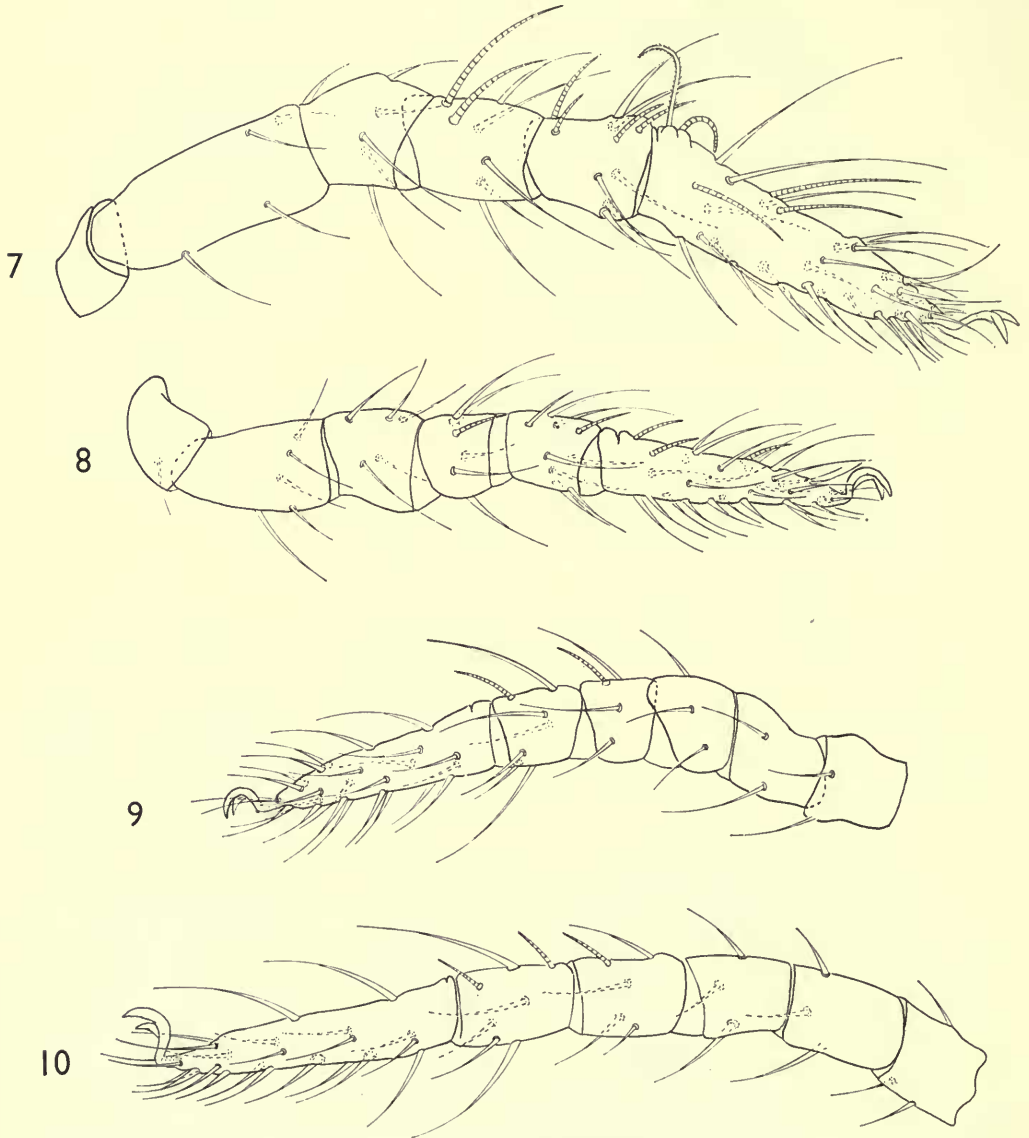
The hysterosoma is about 175 μ in length and approximately 170 μ wide at the broadest point level with setae e_2 . The ‘asthenique zone’ between the posterior border of the propodosoma and the median dorsal sclerite is very short. There are 17 pairs of setae in the gastronotal series. Setae c_1 , cp, d_2 , e_1 , e_2 , f_2 and h_1 are long, barbed, dark brown in colour and arise from tubercles, those of setae e_1 being particularly prominent. An internal thickening such as Grandjean (1952, 1952a, 1957) has observed for *Stomacarus*, *Archeonothrus* and *Andacarus*, respectively, can be seen below the tubercle of e_1 . Difficulty was experienced in securing specimens with completely undamaged setae but it would appear that the long barbed setae c_1 , c_2 , cp, d_2 and e_2 are about equal in length (i.e. about 170 μ) while the barbed setae f_2 and h_1 may be slightly longer than the total length of the idiosoma. Setae c_1 and the

short smooth c_2 lie together on a median dorsal sclerite, while setae d_2 and the short smooth d_1 lie together on paired sclerites. The remaining gastronotal setae, with the exception of e_2 , are borne individually on small sclerites. Setae f_1 and those of the ps and h series are short, smooth and simple, with the exception of setae ps₂ which are shaped like spear-heads. Setae ps₁ and h₂ are rather blunt.



FIGS. 2-6. *Himalacarus chimalae* gen. et sp. nov. Fig. 2. Adult, dorsum. Fig. 3. Adult, ano-genital region. Fig. 4. Adult, infracapitulum. Fig. 5. Adult, palp. Fig. 6. Tritonymph, venter.

The ano-genital region is shown in fig. 3. There are 3 setae in the anal series (AN) and 4 in the adanal (AD). All these setae lie individually on small sclerites. There are 9 pairs of genital setae and 3 pairs of aggenitals (AG). The 10 pairs of eugenital setae are all approximately similar in size and shape and it is suspected that all the adults collected were males. The coxisternal region is essentially similar to that of the tritonymph (fig. 6), the setal formula being (4-3-4-4).



FIGS. 7-10. *Himalacarus chimalae* gen. et sp. nov. Adult, legs.
 Fig. 7. Leg I. Fig. 8. Leg II. Fig. 9. Leg III. Fig. 10. Leg IV.

The infracapitulum is shown in fig. 4. There are four oral lips and in comparison with other members of the family the lower lip is particularly large and easily seen. The upper lip is also prominent and bears on its under surface a series of minute denticles forming an inverted U-shaped pattern. The three pairs of adoral setae are simple, the anterior pair (or_1) being shorter than the other two. The chelicerae have the characteristic 'ornithocephaline' outline common to other members of the family and carry two setae dorsally. Their fixed digits bear three prominent teeth and the movable digits only two ill-defined shallow projections. The five-segmented palp (fig. 5) has the setal formula (0-2-1-3-18). The solenidion of the palp-tarsus is borne on a prominence immediately distal to the lyriform fissure and of the 18 setae on this segment, 9 are eupathidia.

The legs (figs. 7-10) are relatively stout and robust, legs I and IV being markedly longer than II and III. All the femora are divided. The setal formulae are: I (0-[4-6]-5-6-31); II (1-[5-5]-5-7-27); III (2-[2-3]-3-6-26); IV (3-[3-3]-4-5-23), and the formulae for the solenidia are:— I (2-4-4); II (1-2-3); III (1-1-0) and IV (1-2-0). On tarsus I the famulus, which is slender and ciliated, lies on a small prominence between the lyriform fissure and the proximal solenidion. Of the 31 setae observed on this segment at least 9 can be distinguished as eupathidia. As in *Acaronychus*, only the pleural setae on tarsus II are eupathidial.

On all four legs the ambulacrum has two well-developed lateral claws. A minute blunt central element can also be distinguished but this is evidently very much less developed than in other *Acaronychid* genera.

TRITONYMPH. The number and disposition of dorsal setae are essentially similar to those of the adult. Ventrally (fig. 6) the anal and coxisternal regions are similar to those of the adult although in the figured specimen only 3 adanal setae were present on one side. There are 7 genital and 2 aggenital setae.

The setal formulae for the legs are I (0-(4-6)-5-6-27), II (1-(3-5)-5-7-21), III (2-(1-3)-3-6-21); IV (3-(1-3)-4-5-17). The formulae for the solenidia are the same as those for the adult.

OTHER STAGES. Unknown.

SYSTEMATIC POSITION

The Palaeacaroida, now comprising 11 genera, were first recognised as a group by Trägårdh (1932) who considered they should constitute a separate sub-order of the Acari—the Palaeacariformes. A few months later, however, Grandjean (1932) failed to confirm Trägårdh's observation of the presence of mandibular stigmata and concluded that the group should be incorporated with the Oribatei. In 1954, Grandjean considered the group should be regarded provisionally as a super-family—the Palaeacaroida—comprising three distinct families, the *Acaronychidae* (=Archeonothridae), *Palaeacaridae* and *Ctenacaridae*.

Himalacarus shows obvious affinities with the four genera, *Acaronychus*, *Stomacarus*,

Andacarus and *Archeonothrus* which comprise the family Acaronychidae in so much as it possesses all the family attributes listed by Grandjean (1954), namely:

1. A 'naso' and its associated inferior protuberance.
2. A gastronotal series of 34 setae, the long dorsal setae being darkly pigmented.
3. No large asthenique zone.
4. A short hysterosoma without large mediodorsal and pygidial shields.
5. Normal genital papillae and unmodified anterior genital setae.
6. Four oral lips.
7. The anterior adoral setae being much shorter than the other two pairs.
8. A large rounded palp tarsus with 16-19 setae of which 9 are eupathidia.
9. A mandible with an 'ornithocephaline' outline.
10. A first tarsus with a large erect famulus implanted close to the lyriform fissure.

Grandjean further recognised two sub-families, the Archeonothrinae for the 3 genera *Archeonothrus*, *Stomacarus* and *Andacarus*; and the Acaronychinae for the single genus *Acaronychus*. He separated the Archeonothrinae on the basis of their non-claviform famulus and normal female eugenital setae and on the presence of 2 aggenital setae, false lamellae and small internal apophyses at the bases of setae e_2 . The Acaronychinae were characterised by the absence of internal apophyses and false lamellae and by the presence of a dilated famulus, 3 aggenital setae and, in the female, swollen claw-like eugenital setae. However, Grandjean later (1957) observed that the female of *Stomacarus macfarlani*, the species which was subsequently made the type of *Andacarus* (Grandjean 1958a), had claw-like eugenital setae so that this feature had to be abandoned as a sub-familial character.

Although having 3 aggenital setae, *Himalacarus* shows greater overall similarity to the Archeonothrine genera than to *Acaronychus*, thus the number of aggenital setae must also be eliminated from the list of sub-familial features, and, with the reduction of the number of diagnostic sub-familial attributes to two, it might be preferable to consider the family as a single relatively homogenous group. In table 1, the condition of the genera in relation to the main characters which have been used in their classification is summarized.

Since the main part of this account was prepared, Balogh and Csiszár (1963) have published a description of *Stomacarus longicaudatus* from South Argentina. Judging by the figure of the dorsum this species appears to be very close to *H. chimalae* and is probably congeneric with it. It can be noted that in *S. longicaudatus* the dorsal setae d_1 and f_1 are comparatively long and barbed whilst in *H. chimalae* these setae are shorter and smooth.

MATERIAL. *H. chimalae* occurred only in the samples from the Milke Danra forest taken on 2nd December 1961. In all about 40 specimens were collected of which 15 were adult, apparently all males, the remainder being tritonymphs. The greater

TABLE I. THE DISTRIBUTION OF CHARACTER STATES IN THE ACARONYCHIDAE

	<i>Acaronychus</i>	<i>Stomacarus</i>	<i>Andacarus</i>	<i>Archeonothrus</i>	<i>Himalacarus</i>
Lower lip	Very small	Large	Large	Large	Very large
Famulus	Dilated	Slender	Slender	Slender	Slender
Internal apophyses of setae e ₁	Absent	Present	Present	Present	Present
False lamellae	Absent	Present	Present	Present	Present
No. of aggenital setae	3	²	²	²	3
Eugenital setae of female	Swollen, claw-like	Normal	Swollen, claw-like	Normal	?
Setae ps ₂	Spearlike	Slender	Slender	?	Spearlike
Median post-anal sclerite bearing setae h ₁ , h ₂ , ps ₁ & ps ₂	Absent	Absent	Absent	Present	Absent
Setae c ₁ , c ₂	c ₂ on separate paired sclerites	All on single median sclerites	All on single median sclerite	All on single median sclerite	All on single median sclerite
Setae e ₁ , f ₁ , f ₂ ; number of associated paired sclerites	3	3	2 (f ₁ , f ₂ , e ₁)	1	3
Long dorsal setae	Barbed	Smooth	Barbed	Barbed	Barbed

part of the material was collected in the shallow litter layer but a few specimens were found in the underlying mineral soil.

Holotype (1964.5.27.1) and four paratypes (1964.5.27.2-5).

Family **PARHYPOCHTHONIIDAE** Grandjean, 1932

Parhy pochthonius aphidinus Berlese

Parhy pochthonius aphidinus Berlese, A. 1904. *Redia* 2: 25.

Parhy pochthonius sp. Grandjean, F. 1934. *Bull. Mus. Hist. nat. Paris* (2) 6: 423.

The true identity of Berlese's *aphidinus* appears to be doubtful although it seems most probable that the *Parhy pochthonius* species described in detail by Grandjean (op. cit.) is conspecific with this. A single specimen agreeing well with Grandjean's description was recorded from Selap.

Family **HYPOCHTHONIIDAE** Berlese, 1910

Hypochthonius rufulus Koch

Hypochthonius rufulus Koch, C. L. 1836. *Deutsch. Crust. Myr. Arach. Fasc.* 3 t.19.

This common species has a wide holarctic distribution having been recorded from Europe and North America (van der Hammen, 1959) and from Japan (Aoki, 1959). *H. rufulus* occurred in small numbers in the Topke Gola forest but was not recorded from the other localities.

Family **ENIOCHTHONIIDAE** Grandjean, 1947

Eniochthonius minutissimus (Berlese)

Hypochthonius minutissimus Berlese, A. 1904. *Redia* 1: 252.

Hypochthonius pallidulus, Michael, A. D. 1888. *British Oribatidae* 2: 536.

The type locality is Florence and Michael found this species at the roots of ground mosses in Epping Forest. *E. minutissimus* appears to be widely distributed in Europe and in Nepal was found in all localities except Sandakphu. It was most abundant in the Selap forest.

Family **COSMOCHTHONIIDAE** Grandjean, 1947

Cosmochthonius lanatus (Michael)

Hypochthonius lanatus Michael, A. D. 1885. *J. roy. micr. Soc.* (2) 5: 396.

The Nepalese material has been compared with specimens in the Michael collection. Tarsi I are bidactylous while tarsi II-IV are tridactylous and as van der Hammen (1952) has pointed out, Michael was in error when he figured the legs as being monodactylous. Michael collected most of his material from an old thatched roof in Cornwall and considered the species to be uncommon. However, it appears to be widely distributed in soil and litter in Europe and in Nepal was found in all the 4 localities sampled.

Family **PHTHIRACARIDAE** Perty, 1841*Phthiracarus robertsi* sp. nov.

ADULT. The aspis (figs. 11 & 12) ranges in length from about 320–480 μ and is approximately 1.4 times as long as its greatest width immediately behind the sensilli. All the prodorsal setae are weak. The sensillus is distinctly elbowed near the base; proximally the basal portion is slender while at the elbow the sensillus thickens abruptly before tapering gradually to a fine point. There are distinct lateral ridges as well as a very pronounced broad median crest while behind the bothridium the integument is raised into a series of longitudinal corrugations.

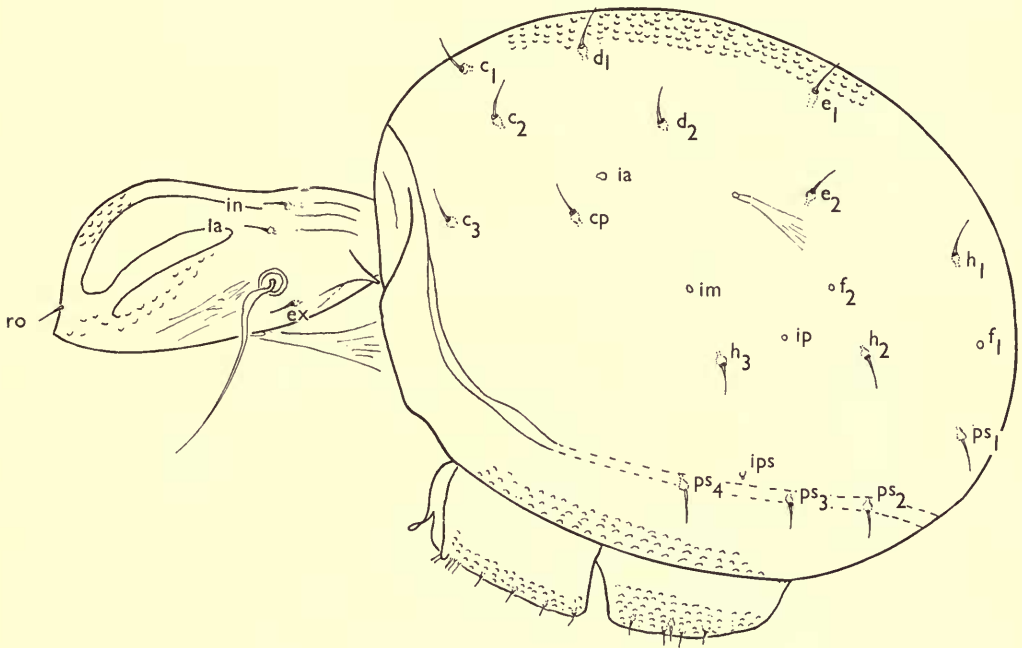
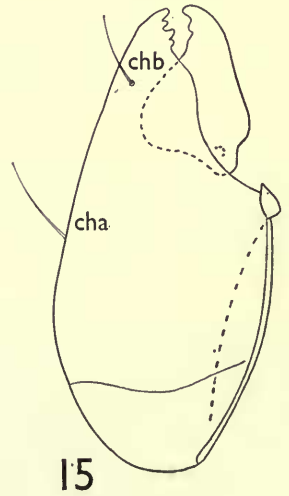
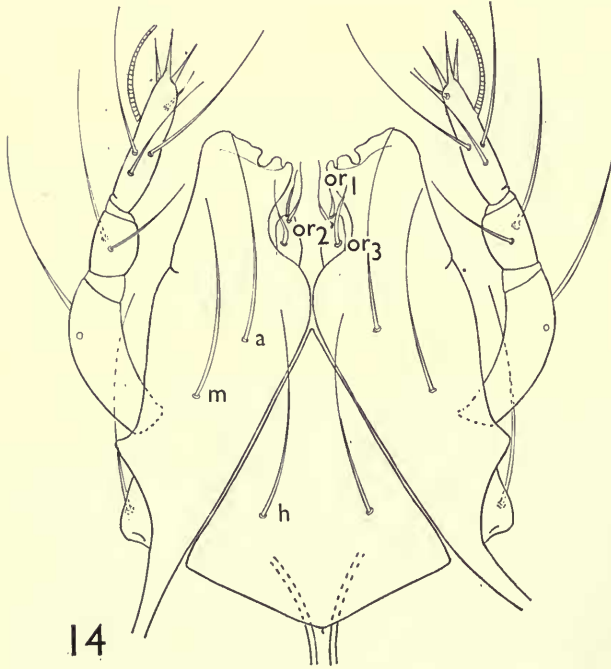
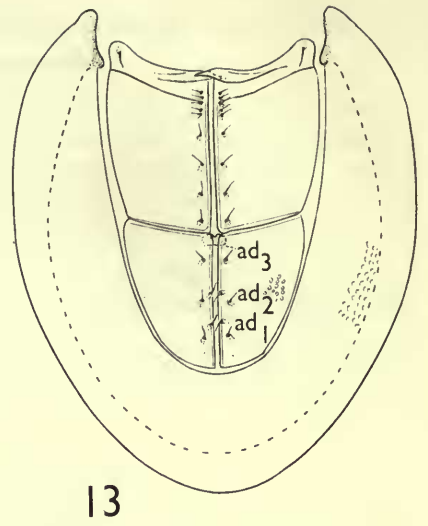
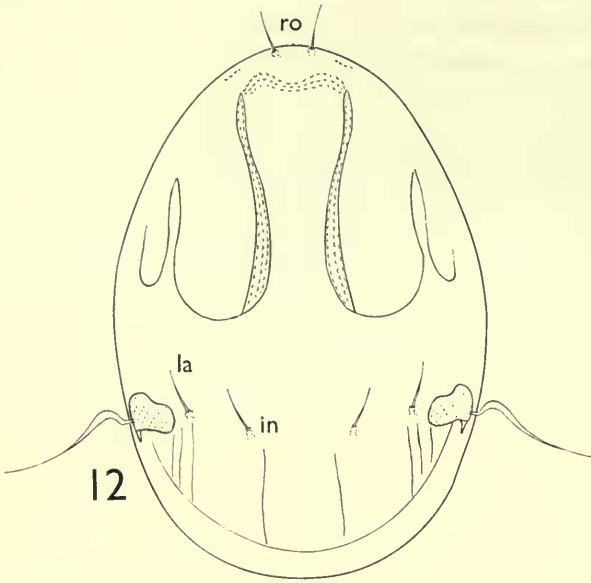
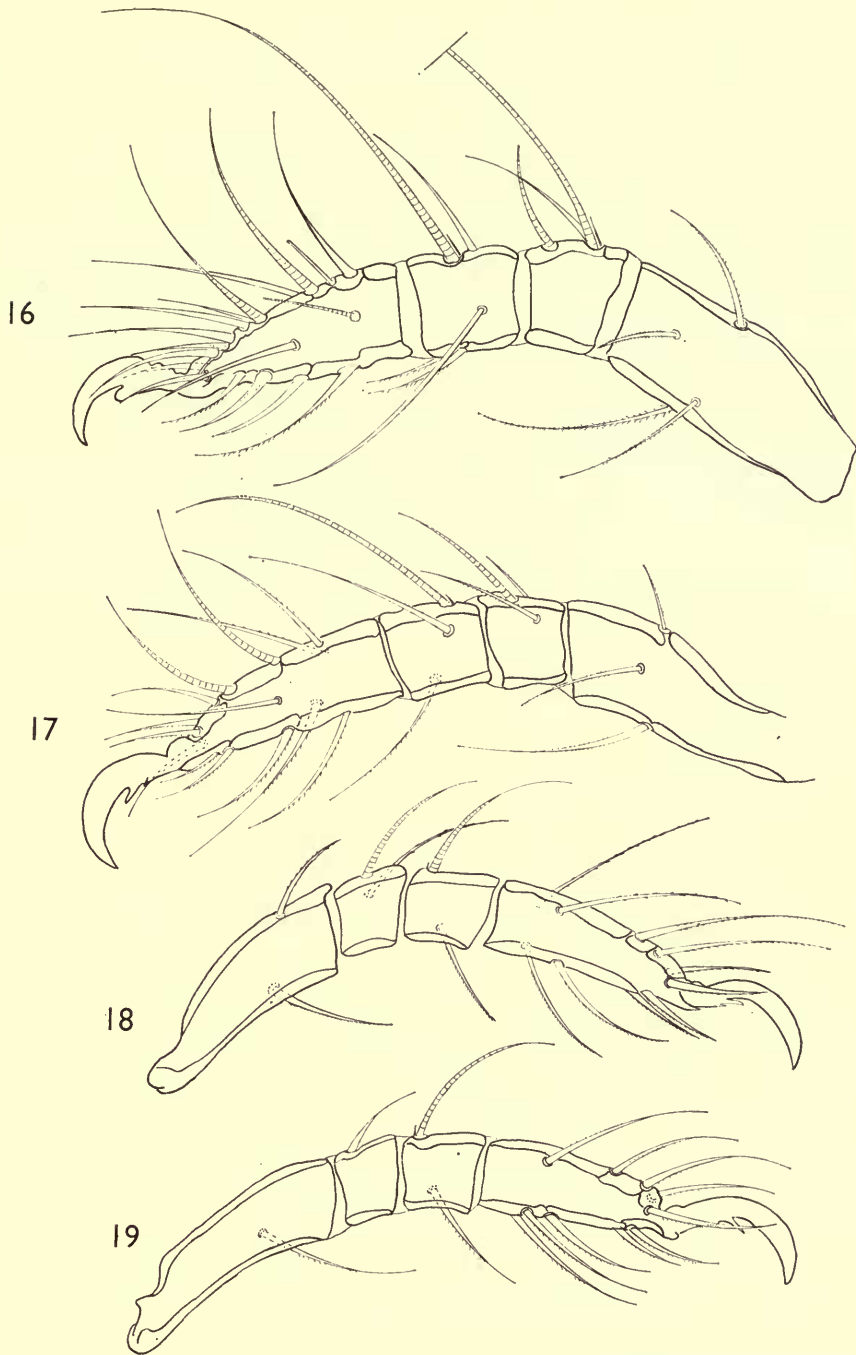


FIG. 11. *Phthiracarus robertsi* sp. nov. Lateral.

Along the line c_3 – h_1 the notogaster ranges in length from approximately 475–830 μ . It is highly arched and, excluding the vestiges of f_1 and f_2 , carries 15 pairs of very weak short setae. The fissures ia , ip and ips are well marked as also is the muscle insertion point anterior to seta e_2 . The notogastral integument is distinctly pitted. The ano-genital region is shown in fig. 13. There are five setae on each anal valve and of these, two, evidently belonging to the anal series, are quite distinctly located nearer the median border than the other three. All the anal and adanal setae are very fine but equally well developed—cf. van der Hammen (1963 a) for *P. laevigatus* (Koch). There are nine genital setae and a single aggenital seta. All the genital setae are marginal and the anterior five setae are inserted more closely together than the posterior four.



FIGS. 12-15. *Phthiracarus robertsi* sp. nov. Fig. 12. Aspis
Fig. 13. Ano-genital region. Fig. 14. Infracapitulum. Fig. 15. Chela.



FIGS. 16-19. *Phthiracarus robertsi* sp. nov. Legs, excluding trochanters.
Fig. 16. Leg I. Fig. 17. Leg II. Fig. 18. Leg III. Fig. 19. Leg IV.

The infracapitulum is shown in fig. 14. The mentum is sub-trapezoidal in outline and carries a single pair of long smooth setae while each gena carries two pairs of similar setae. The three pairs of adoral setae are smooth and slightly sinuous. The three-segmented palp has the formula (2-2-7) and of the tarsal setae, three are eupathidia. The chelicerae are shown in fig. 15. The fixed digit has three teeth and the movable digit carries only a single tooth. Seta chb is located well down on the anti-axial face, while seta cha is dorsal.

The legs are shown in figs. 16-19. The solenidia of the tarsi are all free, while on each tibia the solenidion is coupled with a minute dorsal seta as also is the proximal solenidion on genu I. The solenidion on tibia 1 extends beyond the tip of the tarsus and the solenidion on genu 1 is about the same length as leg I. All the legs are mono-dactyl and the formulae for the setae and solenidia are as follows:—

I (1-4-2-5-15) and (2-1-3); II (1-3-2-3-12) and (1-1-2);

III (2-2-1-2-10) and (1-1-0); IV (2-1-1-2-10) and (0-1-0).

This species is of some interest as the arrangement of setae on the anal valves approaches the condition commonly associated with species of *Steganacarus*. This species is dedicated to Lt. Colonel J. O. M. Roberts M.C., formerly Military Attaché, British Embassy, Kathmandu, in appreciation of his assistance to the East Nepal Expedition.

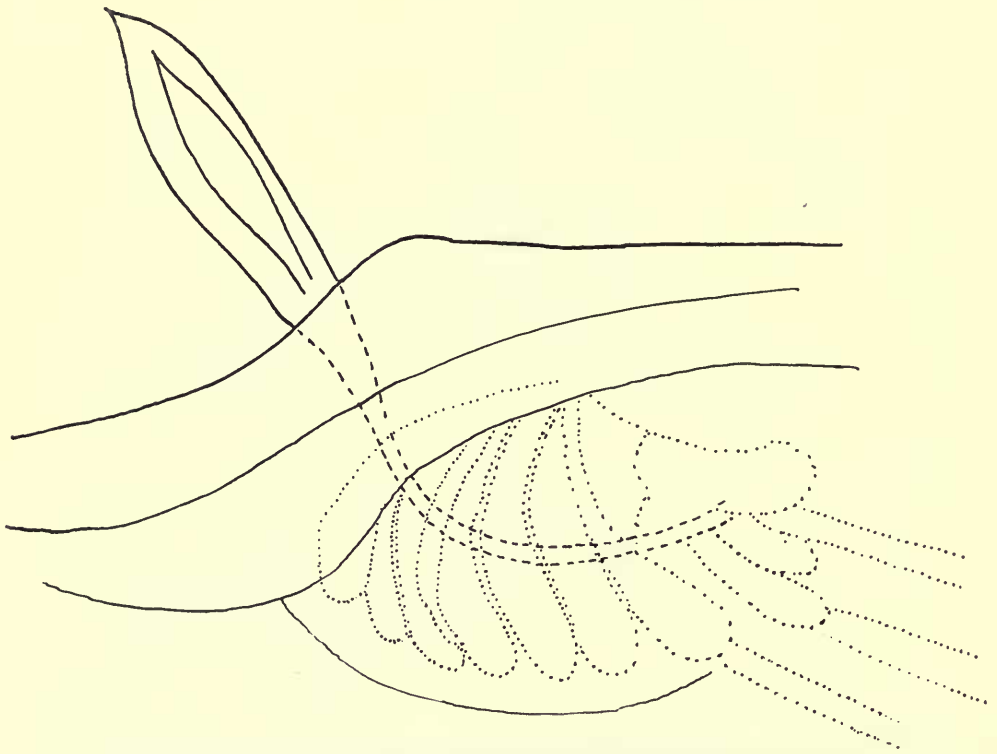


FIG. 20. *Phthiracarus* cf. *laevigatus* Koch. Sensillus of Nepalese specimen.

MATERIAL. Holotype (1964.6.19.1) and five paratypes (1964.6.19.2-6) Milke Danra, 24.xi.61. This species was not abundant and was recorded only from the Milke Danra forest.

Phthiracarus cf. *laevigatus* (Koch)

Hoplophora laevigata Koch, C. L. 1841. *Deutsch. Crust. Myr. Arach. Fasc.* 38 t.16.

Phthiracarus laevigatus, van der Hammen, L. 1963. *Acarologia* 5: 704.

Six specimens evidently referable to this species were taken at Sandakphu. The material agrees reasonable well with van der Hammen's redescription but the form of the sensillus in the Nepalese specimens (fig. 20) appears to differ slightly. In the Nepalese material the first adoral seta is feathered, a feature not mentioned by van der Hammen.

Hoplophthiracarus nepalensis sp. nov.

ADULT. The aspis (figs. 21 & 22) ranges in length from about 215-290 μ and is approximately 1-2 times as long as its greatest width immediately behind the sensilli. The rostral (ro), lamellar (la) and exobothridial (ex) setae are short and simple, while the interlamellar setae (in) are stout, feathered apically, nearly erect, and about three times as long as the rostrals. The sensilli are elbowed and taper gradually to a fine point with slight apical feathering. The prodorsal integument is coarsely pitted and behind the sensilli is raised into a series of low longitudinal ridges.

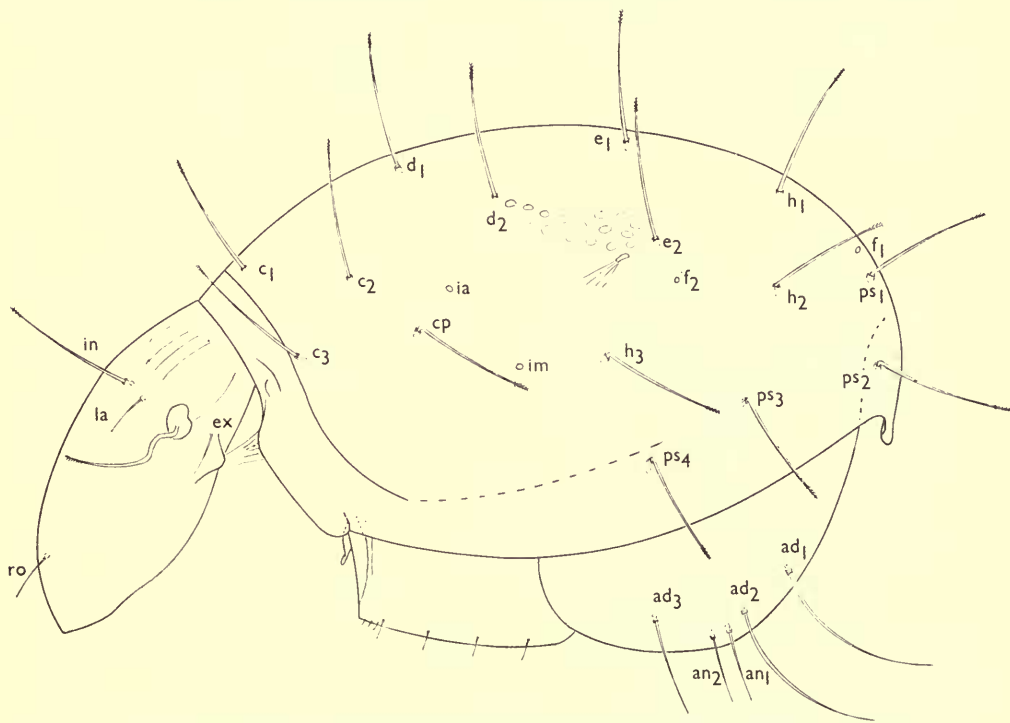
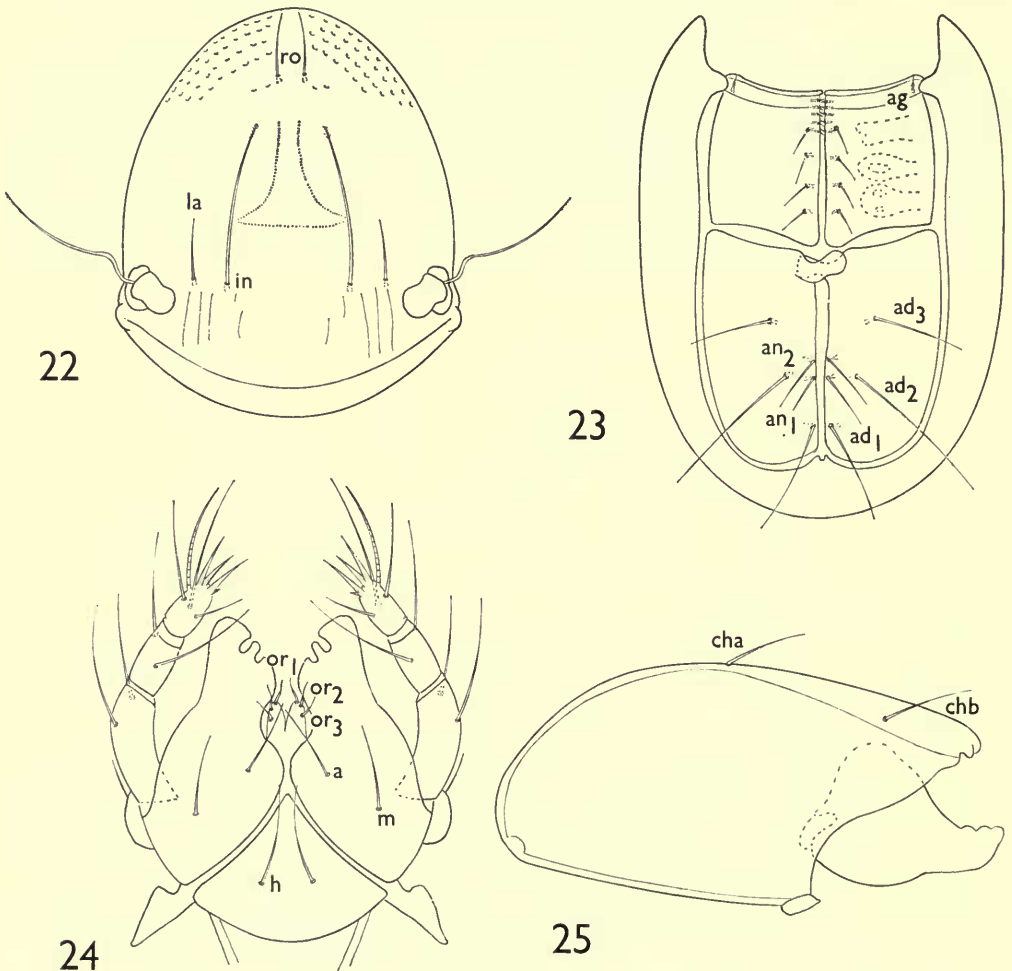
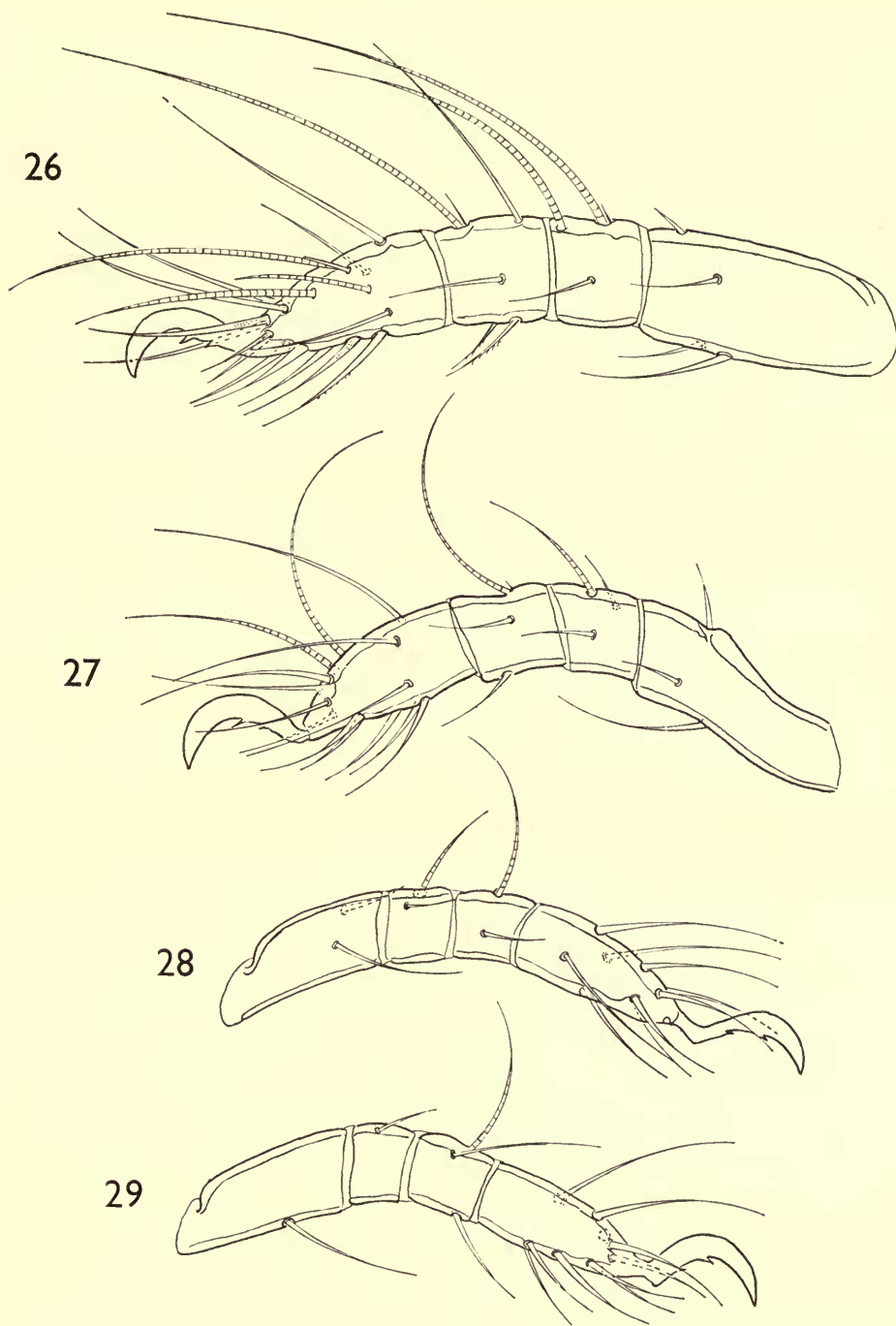


FIG. 21. *Hoplophthiracarus nepalensis*. sp. nov. Lateral.

Along the line c_3 - ps_1 , the notogaster ranges in length from about 330–500 μ , and, excluding the vestigial f_1 and f_2 there are 30 setae in the notogastral series. All the notogastral setae are strong, nearly erect, weakly feathered apically and about equal in length. Only the fissures ia and im could be discerned. The notogastral integument is coarsely pitted, the margins of the pits being irregular. Ventrally (fig. 23) the anal valves have prominent antero-median overlapping lobes, the right overlying the left. The two anal setae are marginal and comparatively long while the three adanal setae form an oblique row, the longest in the series being ad_2 , which is approximately 2–5 times as long as the anal setae. There are nine pairs of genital setae and a single pair of aggenitals. The posterior four pairs of genital setae are comparatively long and situated in a line somewhat remote from the margin, whilst the anterior five



FIGS. 22–25. *Hoplophthiracarus nepalensis* sp. nov. Fig. 22. Aspis. Fig. 23. Ano-genital region. Fig. 24. Infracapitulum. Fig. 25. Chela.



FIGS. 26-29. *Hoplophthiracarus nepalensis* sp. nov. Legs, excluding trochanters.
Fig. 26. Leg I. Fig. 27. Leg II. Fig. 28. Leg III. Fig. 29. Leg IV.

pairs are minute and marginal. There are three pairs of genital papillae, the anterior papillae being rather small (cf. van der Hammen 1963, p. 314 for *H. pavidus* Berlese which has only two pairs of genital papillae). The ornamentation of the integument of the genital and anal valves is similar to that of the notogaster.

The infracapitulum is shown in fig. 24. The mentum is subtrapezoidal in outline and carries a pair of long simple setae (h). The genae carry two pairs of setae (a & m); setae m being about 1.5—2 times as long as setae a. There are three pairs of simple adoral setae. The three-segmented palp has the setal formula (2-2-7) and at least three of the tarsal setae are eupathidial. The minute dorso-anterior seta appears to be discrete and may be eupathidial. The chelicerae are shown in fig. 25.

The legs are shown in figs. 26-29. It is interesting to note that the solenidion on genu I and the solenidia on tibiae I-III are coupled with minute dorsal setae, while the solenidion on tibia IV is free. This condition also appears to obtain in *H. pavidus* (Berlese), (van der Hammen 1963). All the legs are monodactyl and the formulae for the setae and solenidia are as follows:

I (1-4-2-5-15) and (2-1-3); II (1-3-2-3-12) and (1-1-2);
III (2-2-1-2-10) and (1-1-0); IV (2-1-1-2-10) and (0-1-0).

H. nepalensis appears to be very similar to *H. robustior* Jacot which was taken from second growth pine at Pensacola, Florida, U.S.A. Jacot (1933) did not figure the venter of *H. robustior* but noted that the anal and genital plates were 'scrolled' and not 'pock marked'. In *H. nepalensis* both the anal and genital valves are quite clearly pitted in the same way as the notogaster.

MATERIAL. Holotype (1964.6.24.1) and five paratypes (1964.6.24.2-6) Sandakphu, 12.xi.61. This species was common at Sandakphu but was not found in the other localities.

Steganacarus striculus (Koch)

Hoplophora stricula Koch, C. L. 1836. *Deutsch. Crust. Myr. Arach. Fasc. 2* t. 10.

Steganacarus striculus, Feider, Z. & Suciú, I. 1957. *Stud. Cerc. stiint. Biol. Agric. Acad. R.P.R.* 8: 33.

The Nepalese material conforms closely to the redescription of this species by Feider and Suciú (op. cit.) and by Aoki (1958). In comparison with British material however the Nepalese specimens have rather stouter notogastral setae and the apical feathering of these setae is well marked i.e. as figured by Fieder & Suciú. *S. striculus* has a wide holarctic distribution and in Nepal was particularly abundant in the Milke Danra and Topke Gola forests. It was prominent in Selap but only a few specimens were taken at Sandakphu.

Family EUPHTHIRACARIDAE Jacot, 1930

Euphthiracarus inglisi sp. nov.

ADULT. The aspis (figs. 30 & 31) ranges in length from approximately 260-330 μ and is about 1.3 times as long as its greatest width at the level of the sensilli. The rostral setae (ro) are long and smooth and about 1.5 times the length of the lamellar

setae (la). Both the lamellar and the interlamellar setae (in) are slightly feathered apically and the latter are about 1.6 times the length of the former. There is a very pronounced scale below the bothridium, and the sensilli, which are elbowed, taper to a comparatively blunt point with very slight apical feathering. The prodorsal integument is coarsely pitted.

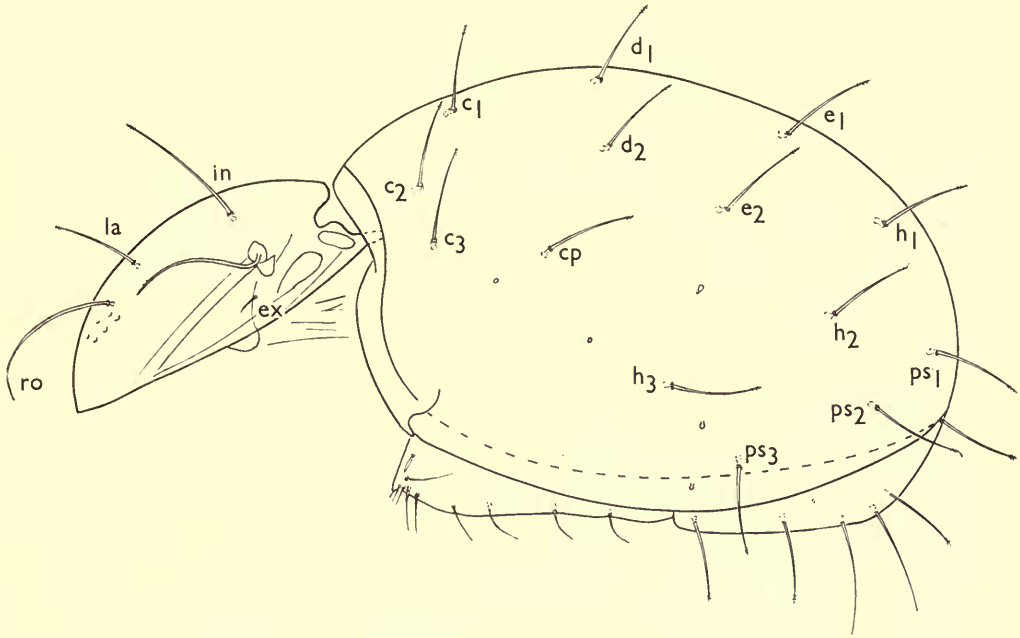
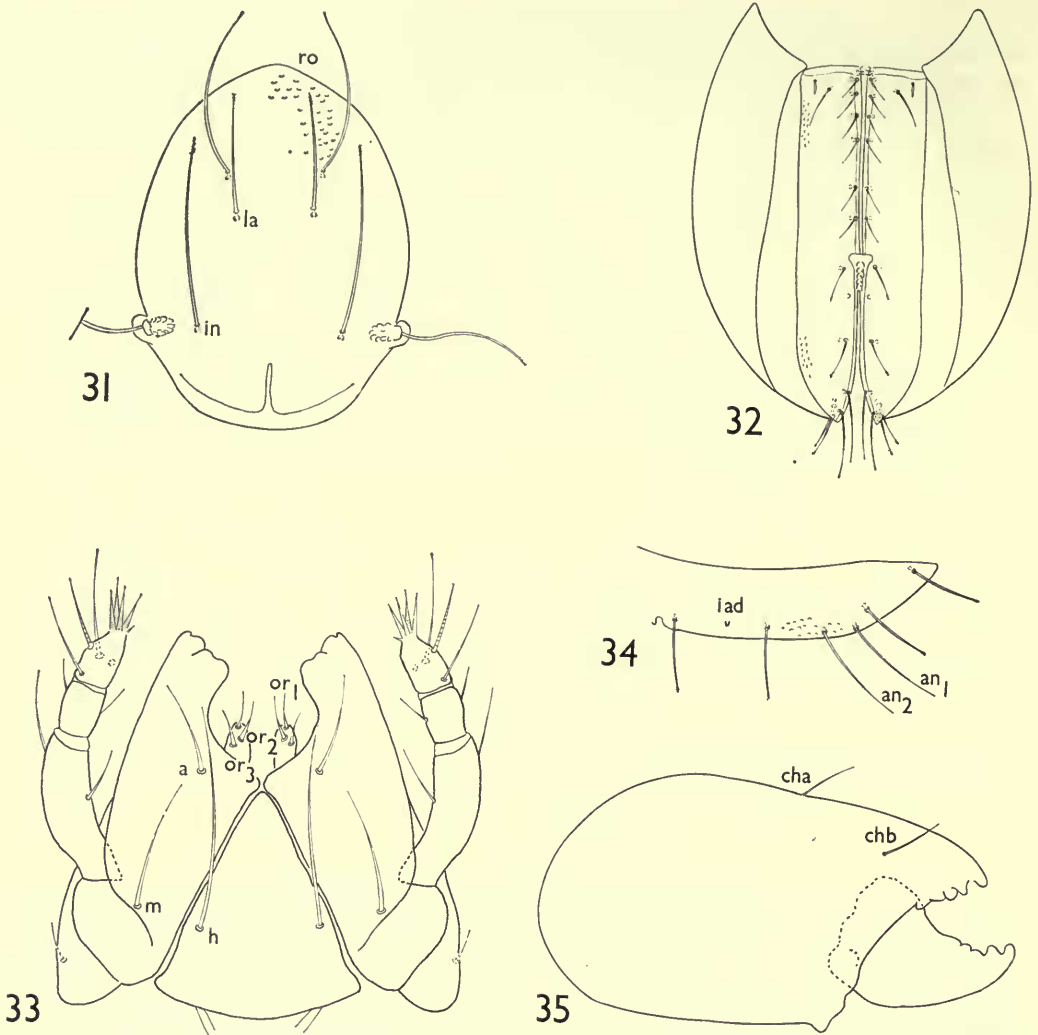


FIG. 30. *Euphthiracarus inglisi* sp. nov. Lateral.

At the level of seta h_2 the notogaster (fig. 30) ranges in length from 475 to 620 μ . The 14 pairs of setae in the notogastral series are all equal in length, erect and slightly feathered apically. The ornamentation of the notogastral integument, consisting of very weak pits, is barely discernible. Ventrally (fig. 32), the anal portion of the ano-genital valve carries six pairs of setae and a single pair of pores. Posteriorly the ano-genital plate is very much produced dorsally so that the position of the posterior setae is difficult to discern in the whole animal, but on dissection (fig. 34) the most posterior pair are seen to be inserted near the notogastral border. Of the six pairs of setae on the anal valves, two are marginal, quite smooth and distinctly longer than the other four. The latter are removed from the margin and slightly feathered apically as in the case of the notogastral setae. There are nine pairs of genital and two pairs of aggenital setae. The anterior pair of aggenital setae are short and narrowly lanceolate. The integument of the ano-genital region is distinctly pitted.

The infracapitulum is shown in fig. 33. The sub-triangular mentum carries a single pair of long setae (h). The genae carry two pairs of simple setae (a & m), seta m being rather longer than a, and there are three pairs of simple adoral setae. The three-segmented palp has the setal formula (2-2-8) and at least four of the tarsal

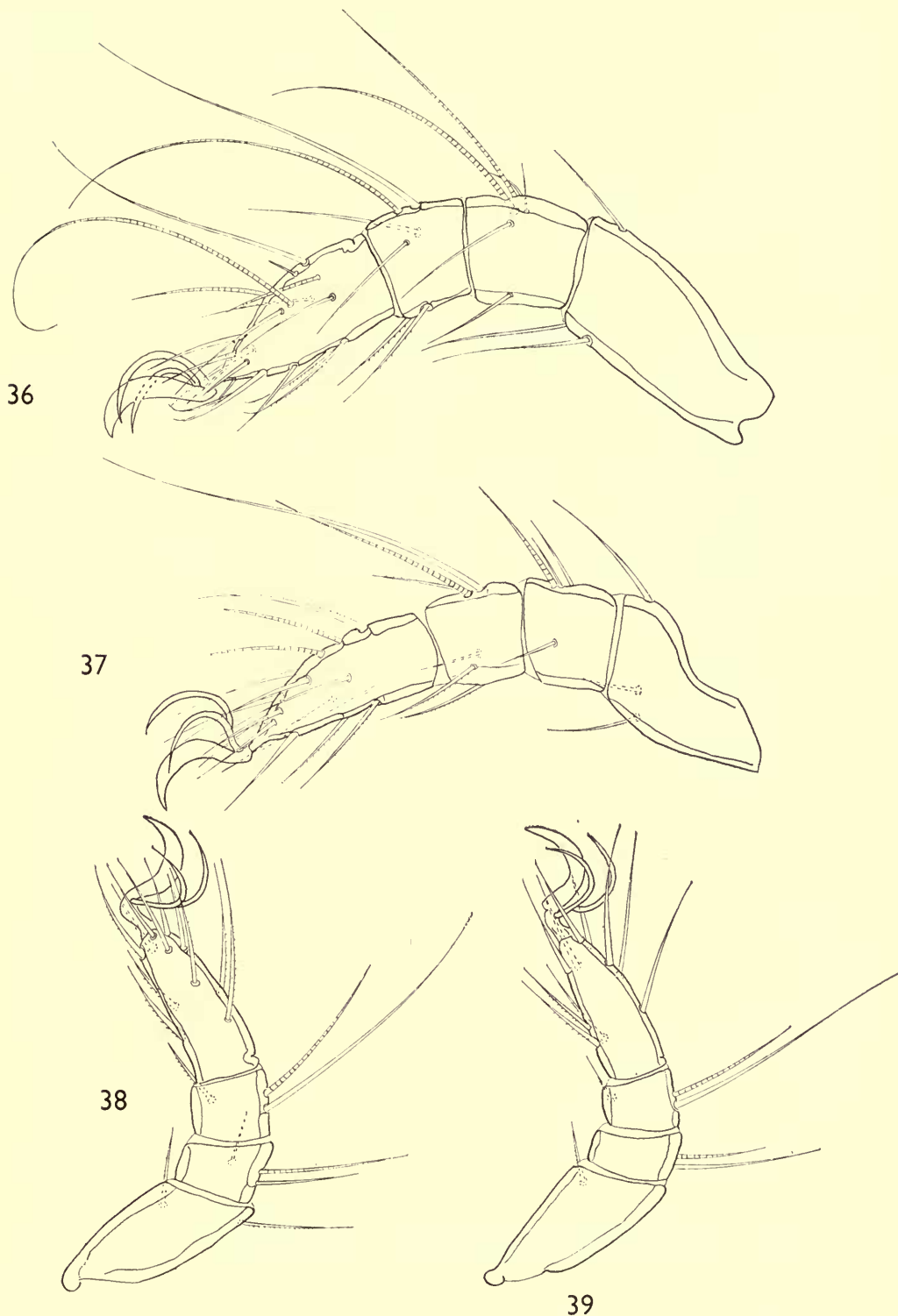


FIGS. 31-35. *Euphthiracarus inglisi* sp. nov. Fig. 31. Aspis. Fig. 32. Ano-genital region. Fig. 33. Infracapitulum. Fig. 34. Anal valve—dissected. Fig. 35. Chela.

setae are eupathidial. The minute dorso-anterior seta is discrete and has the appearance of being eupathidial. The chelicerae are shown in fig. 35. Seta cha is dorsal and seta chb is inserted well down on the antiaxial face. Each digit has four teeth.

The legs are shown in figs. 36-39. A noticeable feature is that on all the tibiae the dorsal seta is extremely long and on legs II-IV exceeds the tibial solenidia in length. All the tarsi are tri-heterodactyl and the formulae for the setae and solenidia are as follows:—

I (1-3-4-5-16) and (2-1-3); II (1-3-3-5-14) and (1-1-2);
 III (2-2-2-2-11) and (1-1-0); IV (2-1-1-2-10) and (1-1-0).



FIGS. 36-39. *Euphthiracarus inglisi* sp. nov. Legs, excluding trochanters.
Fig. 36. Leg I. Fig. 37. Leg II. Fig. 38. Leg III. Fig. 39. Leg IV.

E. inglisi is very similar to *E. flavus* (Ewing). However, an examination of a specimen of the latter collected in Illinois, revealed that, in contrast to *E. inglisi*, the notogastral integument is very heavily ornamented and the rostral setae are very much shorter than those of *E. inglisi*. Moreover, in *E. flavus* the distal third of the sensillus is distinctly feathered whilst in *E. inglisi* the feathering is slight and confined to the tip. This species is dedicated to my colleague on the East Nepal Expedition, Dr. W. G. Inglis.

MATERIAL. Holotype (1964.7.2.1) and five paratypes (1964.7.2.2-6), Sandakphu, 12.xi.61. *E. inglisi* was common at Sandakphu but was not found in the other localities.

Rhysotritia ardua (Koch)

Hoplophora ardua Koch, C. L. 1841. *Deutsch. Crust. Myr. Arach. Fasc. 32* t.15.

Pseudotritia loricata, Feider, Z. & Suci, I. 1957. *Stud. Cerc. stiint. Biol. Agric. Acad. R.P.R.* 8: 40.

Rhysotritia ardua, Märkel, K. & Meyer, I. 1959. *Zool. Anz.* 163: 341.

This species was extremely common in the Milke Danra and Selap forests. It occurred in small numbers at Topke Gola but was not found at Sandakphu. The Nepalese material has been compared with topotypic material from the Regensberg area kindly provided on loan by Dr. L. van der Hammen. The Nepalese specimens are generally larger and more heavily sclerotized than the topotypic material. Thus,

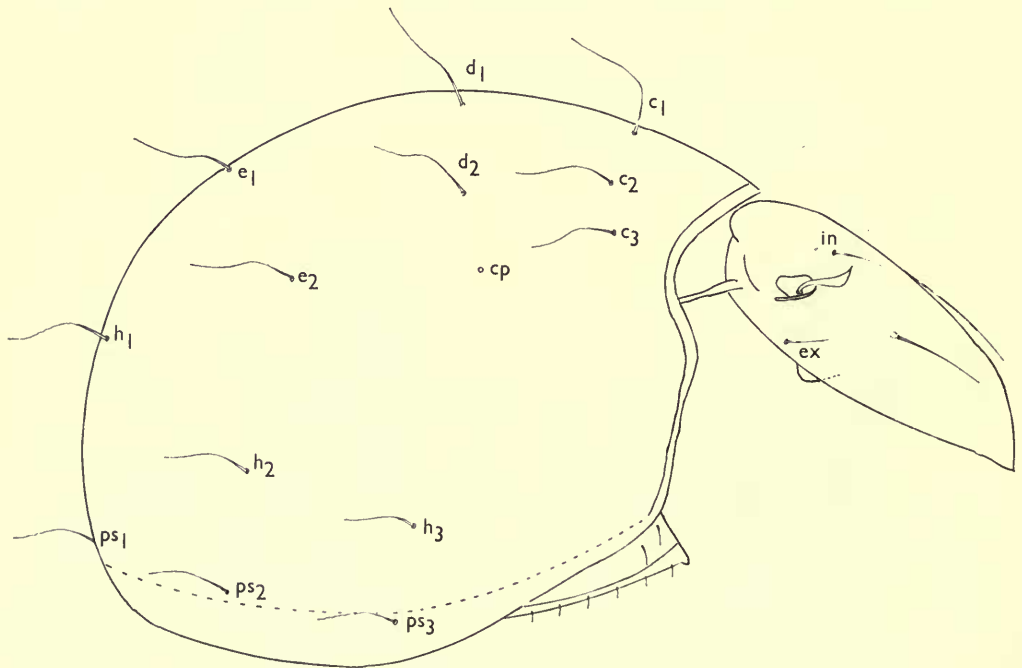
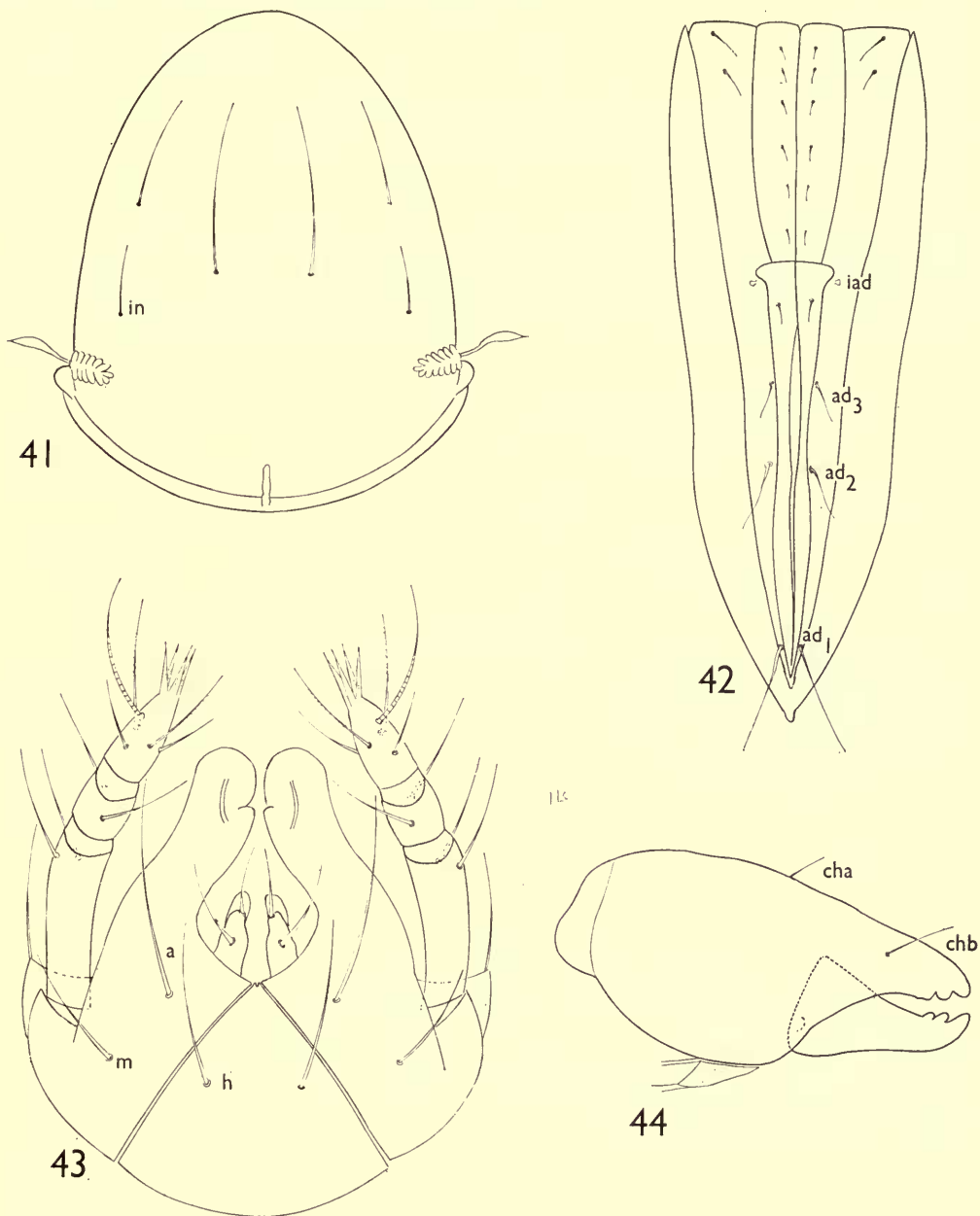


FIG. 40. *Mesotritia maerkeli* sp. nov. Lateral.

the length of the aspis in the Nepal material ranged from about $285-310\mu$ whilst in the six topotypes examined the length of the aspis ranged from about $215-250\mu$. No other morphological differences could be detected.

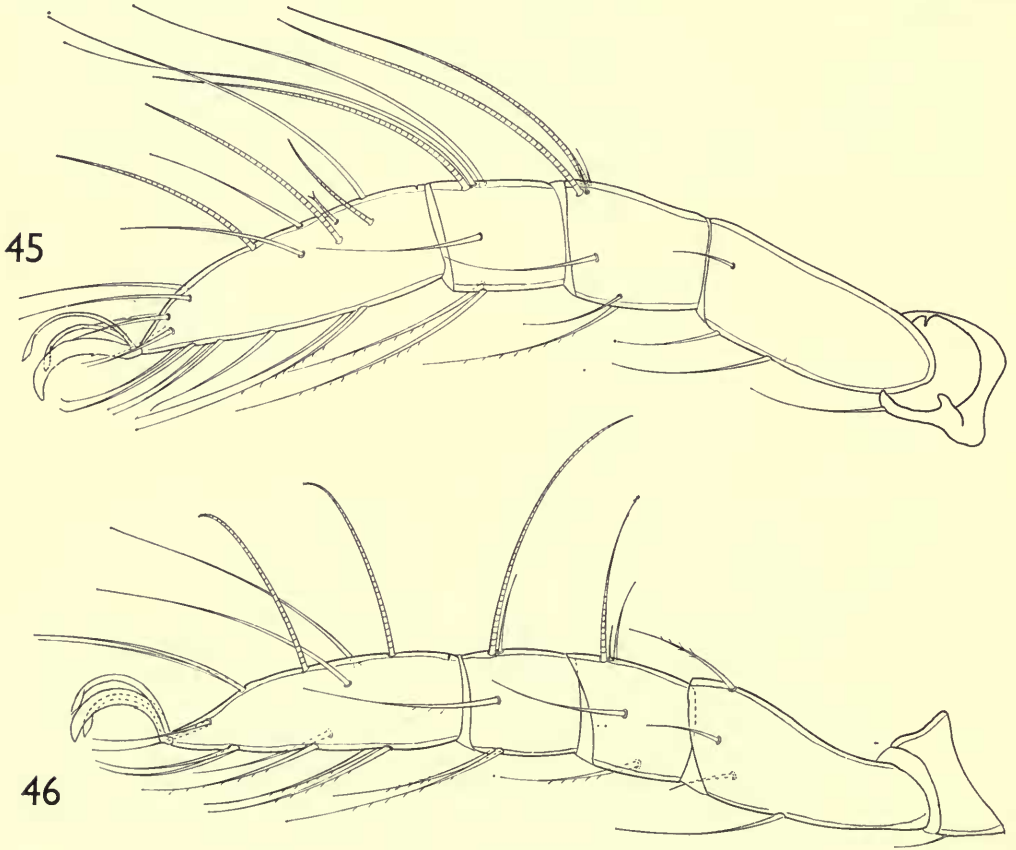


FIGS. 41-44. *Mesotritia maerkeli* sp. nov. Fig. 41. Aspis.
 Fig. 42. Ano-genital region. Fig. 43. Infracapitulum. Fig. 44. Chela.

Mesotritia maerkeli sp. nov.

ADULT. The aspis (figs. 40 & 41) ranges in length from approximately 300–360 μ and is about 1.2 times as long as its greatest width at the level of the sensilli. The rostral setae which are inserted well behind the lamellar setae are long and smooth and about 1.6 times the length of the latter. Both the lamellar and interlamellar setae (in) are smooth. There is a very pronounced scale below the bothridium while the sensilli are short—about the same length as the interlamellar setae—and expanded sub-apically before tapering abruptly to a fine point.

At the level of seta h_1 , the notogaster ranges in length from approximately 550–600 μ . The 14 pairs of setae in the notogastral series are all approximately equal in length, slender and rather weak. The notogastral integument has no distinct ornamentation. Ventrally (fig. 42) the anal valve carries a single pair of setae and there are three pairs of setae in the adanal series. The adanal pore (iad) is located well in front of the anal seta. The genital valve is completely separated



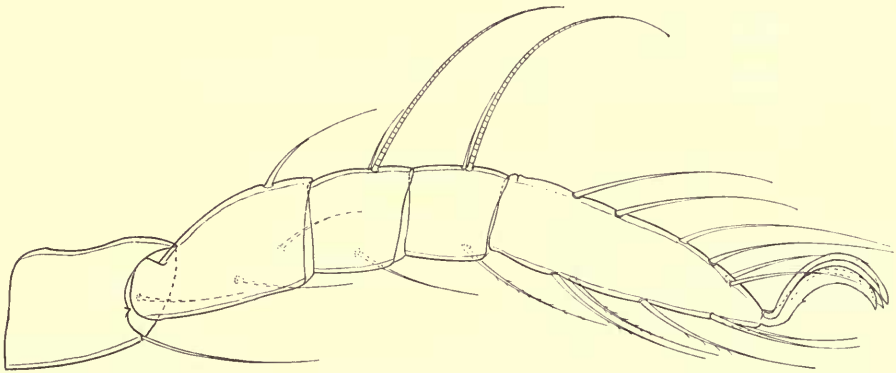
FIGS. 45–46. *Mesotritia maerkeli* sp. nov. Legs.
Fig. 45. Leg I. Fig. 46. Leg II.

from the aggenital plate by a distinct suture while the oblique fissure separating the aggenital from the adanal elements characteristic of *Oribotritia* is lacking. There are six pairs of genital and two pairs of aggenital setae.

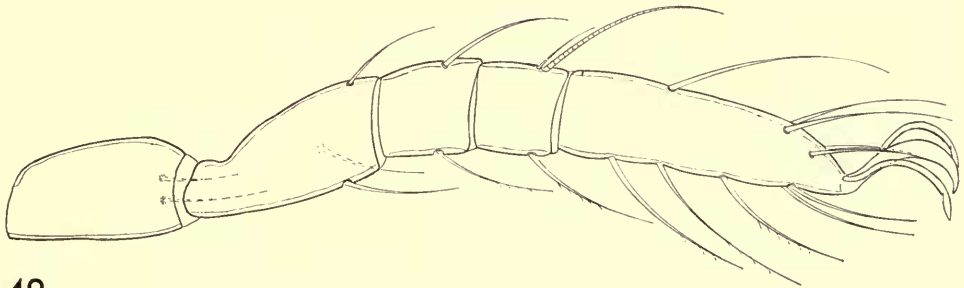
The infracapitulum is shown in fig. 43. The sub-triangular mentum carries a single pair of long simple setae (h). The genae carry two pairs of simple setae (a & m) seta a being about 1.7 times the length of seta m. Only two pairs of adoral setae could be discerned. The three-segmented palp has the setal formula (2-2-8) and four of the tarsal setae are eupathidial. The chelicerae are shown in fig. 44. Seta chb is situated well down on the anti-axial face and both the fixed and movable digits have two teeth.

The legs are shown in figs. 45-48. On leg I the famulus is forked and on all legs the solendia of the tibiae and genua are coupled with dorsal setae, the dorsal setae on tibia 1 being particularly long. All the tarsi are triheterodactyl and the formulae for the setae and solendia are as follows:—

- I (1-3-5-5-17) and (2-1-3); II (1-4-4-4-12) and (1-1-2);
 III (2-3-2-2-11) and (1-1-0); IV (2-3-2-2-10) and (0-1-0).



47



48

FIGS. 47-48. *Mesotritia maerkeli* sp. nov. Legs.
 Fig. 47. Leg III. Fig. 48. Leg IV.

I am indebted to Professor Konrad Märkel, to whom this species is dedicated, for information on the genus *Mesostritia*. Professor Märkel is currently preparing a revision of the Euphthiracaridae and for the present it is sufficient to note that while *M. maerkeli* has affinities with *M. testacea* Forsslund (Forsslund & Märkel 1963) it can be readily separated from the latter by reference to the position of the rostral setae and adanal pore.

MATERIAL. Holotype (1964.7.20.1) and one paratype (1964.7.20.2), Selap, 4.ii.62. Only four specimens were taken and all were found in the Selap Forest.

***Oribotritia berlesei* (Michael)**

Phthiracarus berlesei Michael, A. D. 1898. *Das Tierreich Lief* 3: 81.

Oribotritia decumana, Willmann, C. 1931. *Die Tierwelt Deutschlands Teil* 22: 193.

Oribotritia berlesei, Grandjean, F. 1933. *Bull. Mus. Hist. nat. Paris* 5: 309.

Eight specimens were taken from the Topke Gola forest, four from Selap and one from the Milke Danra forest.

Family **EPILOHMANNIIDAE** Oudemans, 1923

***Epilohmannia cylindrica* (Berlese)**

Lohmannia cylindrica Berlese, A. 1904. *Redia* 2: 23.

Lesseria szanisloi Oudemans, A. C. 1917. *Arch. Naturgesch.* 88A. (6): 79.

A single specimen agreeing well with Oudemans' description was recorded from Selap.

Family **EULOHMANNIIDAE** Grandjean, 1931

***Eulohmannia ribagai* Berlese**

Lohmannia (Eulohmannia) ribagai Berlese, A. 1910. *Redia* 6: 223.

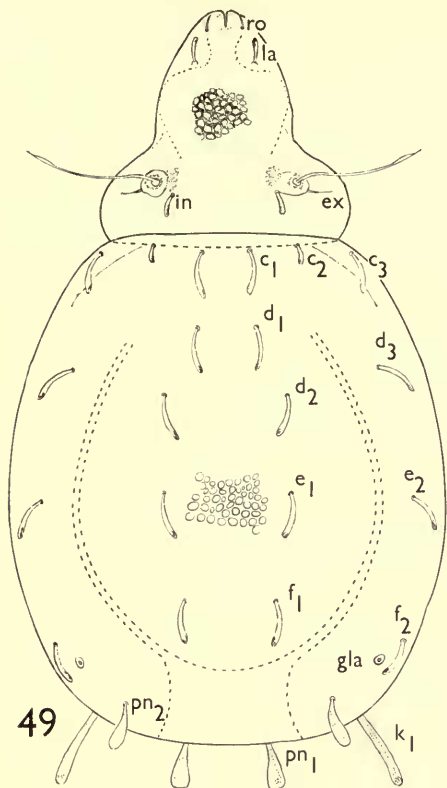
Arthronothrus biunguiculatus Trägårdh I. 1910. *Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland* 4: 544.

Generally regarded as a relict, this species has a wide holarctic distribution (Balogh 1961). In Nepal a small number of specimens was taken at Topke Gola and a single specimen was recorded from Selap.

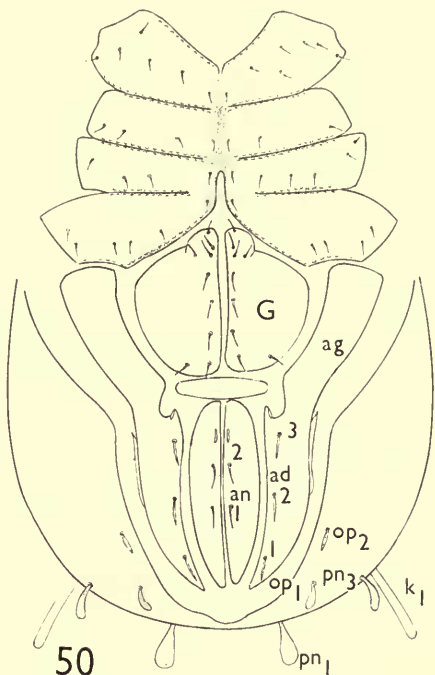
Family **NOTHRIDAE** Berlese, 1896

***Nothrus springsmythi* sp. nov.**

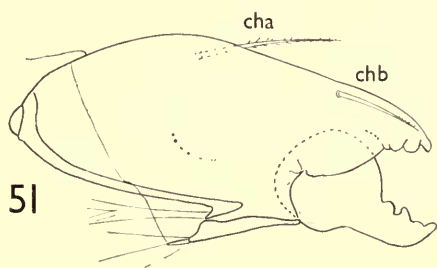
ADULT. The prodorsum (fig. 49) is approximately 350 μ long and 350 μ wide at the broadest point level with the interlamellar setae (in). The median rostral incision extends almost to the base of the rostral setae (ro) and the latter are short and simple while the lamellar (la) and interlamellar setae are narrowly spatulate and serrated apically. The exobothridial setae (ex) are simple. The sensilli are approximately 210 μ in length and slightly expanded in one plane subapically. A cluster of pseudotracheae can be discerned below the bothridia. The integument of the prodorsum is pitted and, centrally, the raised margins of the pits form a regular polygonal network.



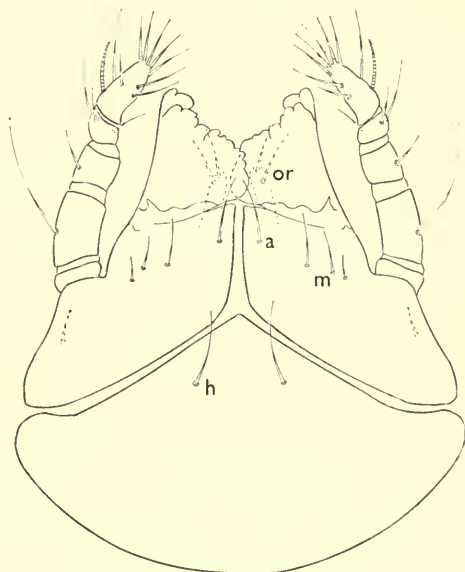
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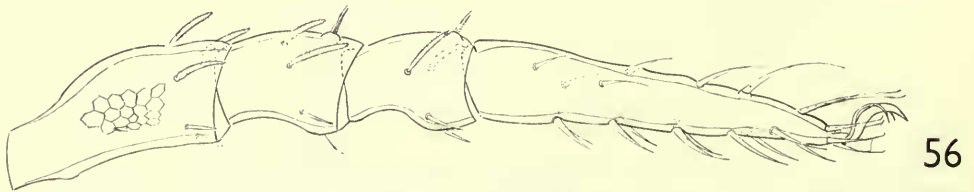
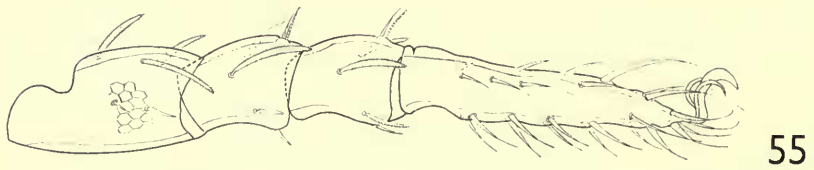
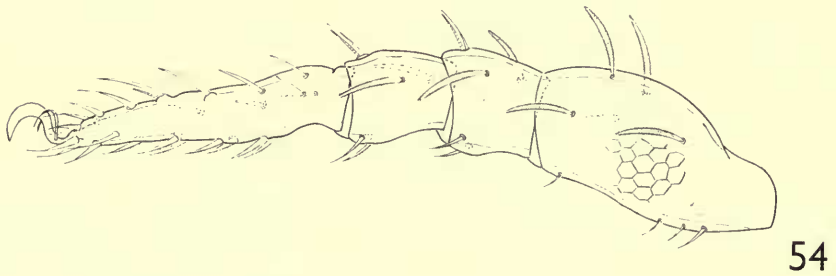
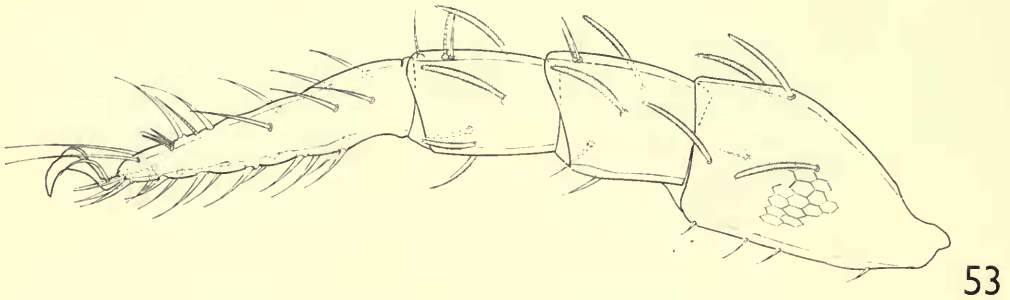
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FIGS. 49-52. *Nothrus springsmythi* sp. nov. Adult. Fig. 49. Dorsum. Fig. 50. Venter. Fig. 51. Chela. Fig. 52. Infracapitulum.

The notogaster (fig. 49) is approximately 720μ in length and about 620μ wide at the broadest point near the level of setae e_2 . There are 16 pairs of notogastral setae, those in the c, d, e and f series being narrowly spatulate. Seta c_1 is about 2.5 times the length of c_2 and the insertion point of the latter is slightly closer to c_1 than to c_3 . The setae of the pn series are broadly spatulate and seta k_1 is about 1.9 times the length of pn_1 . All the setae of the pn and k series have a very prominent core of active chitin with ramifying branches near the tip. The integument of the central part of the notogaster is irregularly pitted, the margins forming a sub-circular pattern.



FIGS. 53-56. *Nothrus springsmythi*. Adult, legs excluding trochanters.
 Fig. 53. Leg I. Fig. 54. Leg II. Fig. 55. Leg III. Fig. 56. Leg IV.

Ventrally (fig. 50) there are two setae in the anal (an) and three setae in the adanal (ad) series. The latter are very narrowly spatulate. Owing to the granular nature of the integument of the epimera the setal bases are difficult to discern. However there appears to be considerable variation in the chaetotaxy of the intercoxal region and the arrangement is not always bilaterally symmetrical. The observed variation in epimera was as follows: I (6-7), II (3-4), III (5) and IV (5-7). This condition is evidently neotrichous, and, as Grandjean (1934) has noted for *Nothrus silvestris* (Nicolet), the 'abnormal' condition first becomes apparent in the protonymph (3-2-3-0), the formula for the larva (2-1-2) being normal (vide infra).

The infracapitulum is shown in fig. 52. The arrangement is 'stenarthric' (Grandjean, 1957a) and the rutella are basically of the *Camisia* type with large overlapping ventral lobes completely covering the adoral papillae. There are two pairs of long simple adoral setae and the four pairs of setae on the genae are arranged in a straight line. The five-segmented palp has the formula (0-1-1-3-9) and four of the tarsal setae are eupathidia.

The chelicera is shown in anti-axial view in fig. 51. It resembles the chelicera of *Camisia* figured by Grandjean (1947) although seta cha is longer and more posteriorly situated. The organ of Trägårdh is discernible only with difficulty.

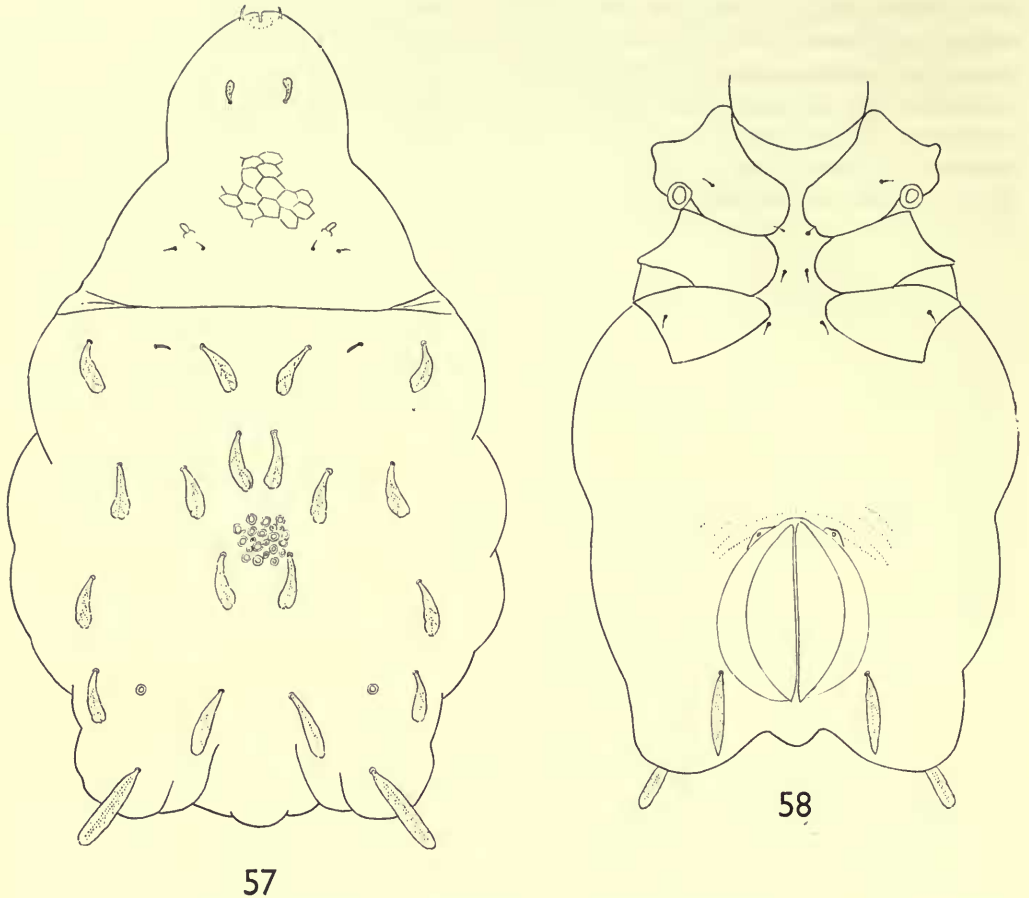
The legs are shown in figs. 53-56. Legs I and IV are much longer than II and III and the integument of trochanters II and IV as well as that of all the femora is sculptured with a distinct polygonal pattern. All the tarsi are tri-heterodactyl and the formulae for the setae and solenidia are as follows:—

I (1-9-5-6-27) and (1-2-3); II (1-9-5-5-24) and (1-1-1);
 III (3-5-5-5-25) and (1-1-0); IV (2-5-5-5-22) and (1-1-0).

LARVA. The prodorsum (fig. 57) is approximately 165μ long. The lamellar setae (la) are spatulate while the remaining prodorsal setae are simple. The sensilli are represented by short stumps. Along the mid-line the notogaster is approximately 260μ in length and the integument is tuberculate. With the exception of setae c_2 and k_1 , all the dorsal setae are broadly spatulate. Setae c_2 are simple but somewhat blunt and less than one third of the length of setae c_1 . Setae k_1 are narrowly spatulate and about twice the length of setae f_2 . Ventrally (fig. 58) seta pn_1 is spear-shaped and approximately the same length as k_1 . The structure of the ano-genital region is normal for the genus and the intercoxal formula is (2-1-2). The setal and solenidial formulae for the legs are as follows:

I (0-2-3-4-14) and (1-1-1); II (0-2-3-3-13) and (1-1-1);
 III (0-2-2-3-12) and (1-1-0).

PROTONYMPH. The prodorsum (fig. 59) is approximately 200μ in length and its integument is ornamented with a polygonal pattern. The lamellar (la) and interlamellar setae (in) are broadly spatulate, while the sensilli, approximately 260μ in length, taper to a fine point after bending sharply near the base. Along the mid-line the notogaster is approximately 380μ in length, its integument is tuberculate although this feature is not so well marked as in the larva. With the exception of seta k_1 , all the dorsal setae are broadly spatulate. Seta c_2 is about half as long as seta c_1



FIGS. 57-58. *Nothrus springsmythi* sp. nov. Larva.
Fig. 57. Dorsum. Fig. 58. Venter.

and seta k_1 is about six times the length of seta pn_1 . Ventrally (fig. 60) setae pn_1 and pn_3 are broadly spatulate, while the two pseudanal setae (op) are sub-lanceolate. There are no setae in the anal or adanal series and each crescent-shaped genital shield carries a single seta. The intercoxal formula is (3-2-3-0) and the setal and solenidial formulae for the legs are as follows:

I (0-3-5-5-15) and (1-1-2); II (0-3-5-5-13) and (1-1-1);
III (1-2-4-4-13) and (1-1-0); IV (0-0-0-0-7) and (1-1-0).

DEUTONYMPH. Along the mid line the prodorsum and notogaster are approximately 200 and 450 μ in length, respectively. The arrangement and form of the dorsal setae is essentially similar to that of the protonymph. Setae k_1 are about 180 μ long and 4-5 times as long as setae pn_1 . Ventrally (fig. 61) the pseudanal setae (op) have

become broadly spatulate, while three pairs of simple adanal and four pairs of genital setae have appeared. The setal and solenidial formulae for the legs are as follows:

I (1-7-5-5-19) and (1-2-2); II (1-7-5-5-17) and (1-1-1);

III (3-3-5-5-17) and (1-1-0); IV (1-2-4-4-13) and (1-1-0).

TRITONYMPH. Along the mid-line the prodorsum and notogaster are approximately 230 and 650 μ in length, respectively. The arrangement of dorsal setae is essentially the same as in the adult except that the spatulate setae are rather broader. Setae k_1 are about 240 μ long and about 3 times the length of setae pn_1 . Ventrally (fig. 62), the anal region differs from that of the deutonymph by the addition of 2 pairs of anal setae and a pair of anal pores. There are seven pairs of genital setae. The setal and solenidial formulae for the legs are as follows:

I (1-8-5-6-23) and (1-2-3); II (1-7-5-5-17) and (1-1-1); III (3-3-5-5-17) and (1-1-0) and IV (1-2-4-4-13) and (1-1-0).

Nothrus springsmythi appears to have affinities with *Nothrus biciliatus* C. L. Koch. However, European specimens of the latter kindly provided by Dr. K.-H. Forsslund had an overall length of 790-800 μ , whilst *N. springsmythi* is much larger ranging in length from 1070-1130 μ . Moreover, in *N. springsmythi* setae k_1 are much more slender although the form of these setae, as well as that of setae pn_1 , seems to vary considerably. An interesting difference can also be seen in the form of the setae on the tarsi. In *N. biciliatus* the three proximal latero-dorsal setae of the tarsi are markedly spatulate with a sickle-like curve, whilst in *N. springsmythi* these setae are much more slender and of the same type as the proximal ventral setae.

N. springsmythi also resembles two recently described South American species viz. *Nothrus oblongus* Hammer 1961, and *Nothrus macedi* Beck 1962. It differs from the latter in lacking the tubercle at the base of seta pn_2 , by having a smooth sensillus, comparatively smooth distal setae on the tarsi and also in the length, relative to the basal distance of setae f_1 . In comparison with *N. oblongus*, *N. springsmythi* is larger and stouter. In the former species the first adanal seta is described as being similar to the dorsal hysterosomal setae (narrowly spatulate) whilst in *N. springsmythi* all the adanal setae are very narrowly lanceolate. This species is dedicated to Major T. Le M. Spring Smyth in appreciation of his services to the East Nepal Expedition.

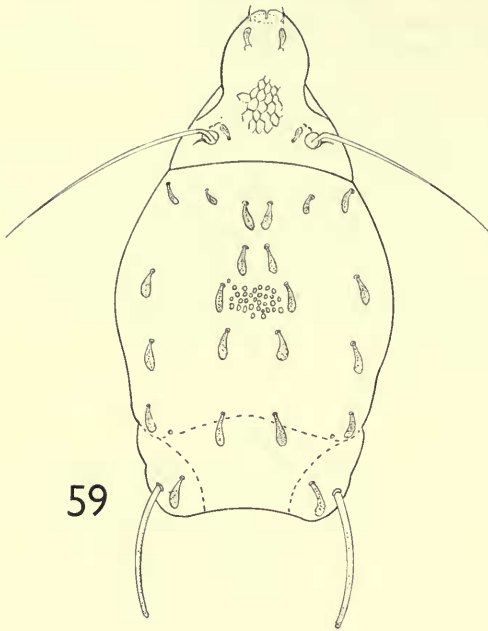
MATERIAL. Holotype adult (1964.6.15.1) and five paratypes comprising an adult and all four postembryonic developmental stages (1964.6.15.2-6), Selap, 4.ii.62. *N. springsmythi* was extremely common in the Milke Danra and Selap forests. It was particularly abundant in the latter locality and in one sample constituted 24% of the Cryptostigmatid population. It was less abundant at Topke Gola and was not found at Sandakphu.

Nothrus palustris Koch

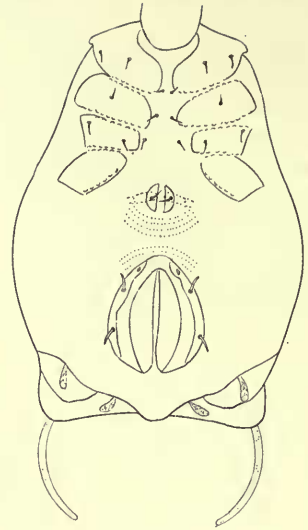
Nothrus palustris Koch, C. L. 1839. *Deutsch. Crust. Myr. Arach. Fasc.* 29 t.13.

Nothrus palustris, Sellnick, M. & Forsslund, K.-H. 1955. *Ark. Zool.* 8: 498.

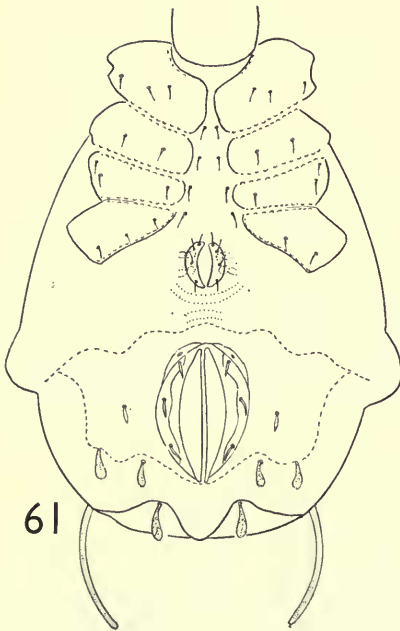
This species dominated the community at Topke Gola. It occurred in small numbers in the Milke Danra and Selap forests and a single tritonymph was recorded from Sandakphu.



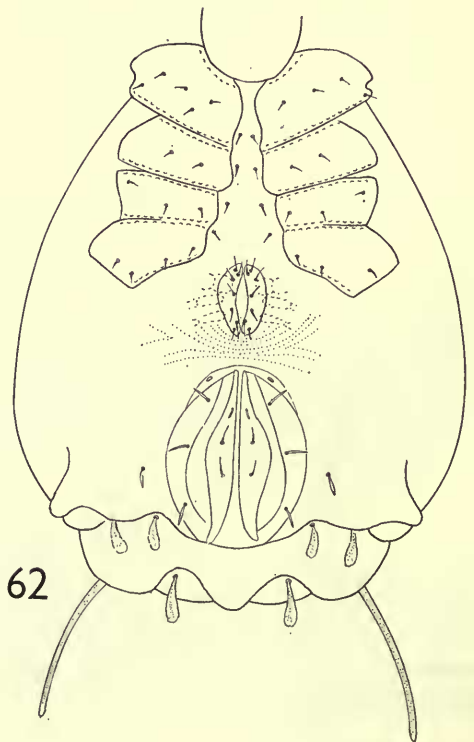
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62

FIGS. 59-62. *Nothrus springsmythi* sp. nov. Fig. 59. Protonymph, dorsum. Fig. 60. Protonymph, venter. Fig. 61. Deutonymph, venter. Fig. 62. Tritonymph, venter.

Family CAMISIIDAE Oudemans, 1900

Camisia lapponica (Trägårdh)

Nothrus lapponicus lapponicus Trägårdh, I. 1910. *Naturwissenschaftliche Untersuchungen des Sarekgebirges in Schwedisch-Lappland* 4: 526.

Camisia lapponica, Sellnick, M. & Forsslund, K.-H. 1955. *Ark. Zool.* 8: 489.

According to Sellnick & Forsslund (op. cit.) this species has a wide holarctic distribution. It occurred in small numbers at Sandakphu.

Platynothrus peltifer (Koch)

Nothrus peltifer Koch, C. L. 1839. *Deutsch. Crust. Myr. Arach. Fasc.* 29 t.9.

Platynothrus peltifer, Sellnick, M. & Forsslund, K.-H. 1955. *Ark. Zool.* 8: 515.

This species, which has a wide holarctic distribution, was found in all four localities, but was most prominent in the Selap and Milke Danra forests. *P. peltifer* was amongst the species recorded from the Sikkim Himalaya by Pearce (1906).

Family TRHYPOCHTHONIIDAE Willmann, 1931

Trhypochthonius tectorum (Berlese)

Hypochthonius tectorum Berlese, A. 1896. *Acar. Myr. et Scorp. Ital. rep. Fasc.* 78 8.

Trhypochthonius tectorum, Willmann, C. 1931. *Die Tierwelt Deutschlands Teil* 22: 103.

The type material appears to have been collected from moss on roofs in Florence (van der Hammen, 1959). This species is widely distributed in Europe and the collections of the British Museum (Nat. Hist.) include three specimens from Pearce's Sikkim-Himalaya collection. This species was particularly common at Topke Gola but occurred in small numbers in all the localities sampled.

Family MALACONOTHRIDAE Berlese, 1916

Malacothrus monodactylus (Michael)

Nothrus monodactylus Michael, A. D. 1888. *British Oribatidae* 2: 528.

This species was common in the Milke Danra and Topke Gola forests and occurred in small numbers at Selap.

Family NANHERMANNIIDAE Sellnick, 1928

Nanhermannia nana auct.

Nanhermannia nana, Willmann, C. 1931. *Die Tierwelt Deutschlands Teil* 22: 96.

Nanhermannia nana, Strenzke, K. 1953. *Zool. Anz.* 150: 73.

Although rather larger, ranging in length from approximately 580–600 μ , the Nepalese specimens agree well with Strenzke's description. Van der Hammen (1959) has shown that Nicolet's *nanus* has been widely misinterpreted and is not identical with *nana* sensu Willmann, but he considered that the latter should not be renamed until detailed redescriptions of Banks' species had been made. This species was plentiful in the Milke Danra and Topke Gola forests.

SUMMARY

Twenty two species of *Oribatei Inferiores* were found in the soil and litter of Rhododendron forests in four localities in East Nepal. The following six species are considered to be new.

1. *Himalacarus chimalae* gen. et sp. nov. (p. 3)
2. *Phthiracarus robertsi* sp. nov. (p. 11)
3. *Hoplophthiracarus nepalensis* sp. nov. (p. 15)
4. *Euphthiracarus inglisi* sp. nov. (p. 18)
5. *Mesotritia maerkeli* sp. nov. (p. 24)
6. *Nothrus springsmythi* sp. nov. (p. 26)

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